Catalogue no. 11-626-X — No. 066
ISSN 1927-503X
ISBN 978-0-660-06951-7

Economic Insights

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Economic Analysis Division

Release date: December 22, 2016

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. not available for any reference period
.. not available for a specific reference period
... not applicable
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0^s value rounded to 0 (zero) where there is a meaningful distinction between true zero and the value that was rounded
^{p} preliminary
^{r} revised
x suppressed to meet the confidentiality requirements of the *Statistics Act*
^{E} use with caution
F too unreliable to be published
* significantly different from reference category ($p < 0.05$)

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This *Economic Insights* article assesses the effect of falling commodity prices on Canadian real income. It is part of a research program that examines links between natural resources and economic growth.

Introduction

Global prices for commodities began to decline rapidly in the middle of 2014 and continued to decline throughout 2015 and early 2016. As the Bank of Canada's commodity price index (BCPI) shows, price changes in international markets for commodities important to Canada registered a decline of 53.7% from the second quarter (Q2) of 2014 to 2016 Q1 (Chart 1). Despite some improvement in commodity prices in 2016 Q2, commodity prices remained well below the levels recorded two years earlier. While prices declined for a variety of commodities over this period, oil price changes were of particular note. West Texas Intermediate fell from US$105.79 per barrel in June 2014 to US$30.32 per barrel in February 2016.[1] Concurrently, the Canada–U.S. exchange rate declined from US$0.91 (US$/CAN$) in September 2014 to US$0.72 in February 2016.[2] Together, these price changes constituted a significant relative-price shock for the Canadian economy.

Chart 1
Bank of Canada commodity price index versus U.S.–Canada exchange rate

Note: BCPI stands for Bank of Canada commodity price index. Q stands for quarter.
Sources: Statistics Canada, CANSIM tables 176-0075 and 176-0064.

How big was the effect of falling commodity prices on Canada?

Characterizing and examining the size of the relative price shock that emanated from global markets during this period is not straightforward. Growth in real gross domestic product (real GDP) is usually a primary metric used for assessing the size and importance of economic shocks. Real GDP shows that Canada's economic growth, in 2015 and 2016, was the weakest since the 2008-2009 recession. After growing strongly through the last three quarters of 2014, real GDP experienced negative quarterly annualized growth in the first half of 2015 (Q1: -1.1%; Q2: -0.4%), showed positive growth in 2015 Q3 (2.5%), but weakened in 2015 Q4 (0.4%). Real GDP growth then strengthened in 2016 Q1 (2.9%) before falling and rebounding over 2016 Q2 (-1.4%) and 2016 Q3 (3.6%), reflecting production

1. U.S. Energy Information Agency: Cushing, Oklahoma, West Texas Intermediate (WTI), Spot Price free on board (dollars per barrel).
2. The average monthly exchange rate reached a low of US$0.70 per CAN$1.00 in January 2016, one month before the price of WTI reached its low-point.

interruptions from wild fires in Fort McMurray, Alberta.[3] Real GDP shows a negative aggregate shock, but one that appears more subdued than the magnitude of the changes seen in global commodity and currency markets.

This occurs because the fall in commodity prices is a relative-price shock, one to which real GDP is not well suited for capturing. In this case, an alternative measure of aggregate real income called real gross national income (real GNI) is preferable for illustrating the timing and magnitude of the shock that affected the Canadian economy during the period, and for illustrating the response of particular variables, such as real imports or real gross fixed capital formation (real GFCF).

Real GDP is a measure of production. It is designed to capture changes in the way real inputs relate to real outputs, or to provide a summary measure of how real consumption, real GFCF, real inventories, real exports and real imports progress through time. To this end, measures of real GDP necessarily remove the effect of price changes, including relative-price changes. In the context of falling commodity prices, this means that measures of real GDP adjust only when there is a change in the volume of production. If resource-extracting industries continue to produce, but receive lower profits, there will be little effect on real GDP growth. For a real effect to materialize, falling prices must affect production.

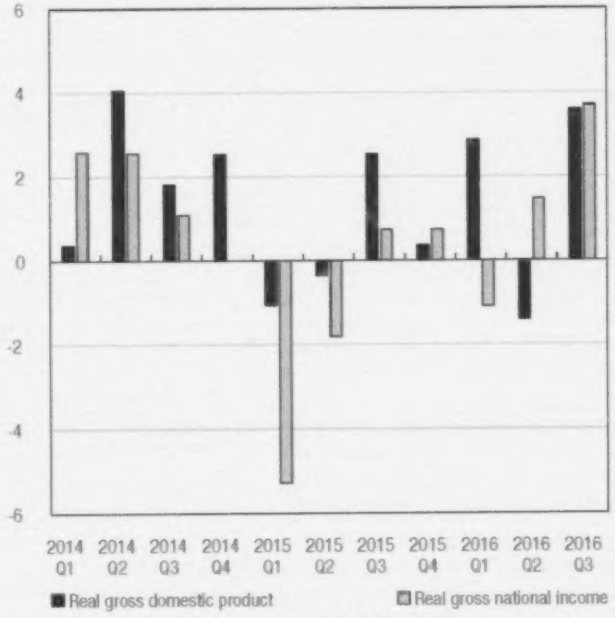
While falling prices do not, of themselves, lead to a change in real GDP, it is important to note that their effect is captured by a change in the GDP deflator. The GDP deflator is designed to illustrate how prices for different components of GDP (e.g., inputs and outputs; or consumption, GFCF, inventories, exports, and imports) change through time. These price changes are the flip side of real GDP. Because each component has a price associated with it, relative-price changes are manifested directly in the GDP deflator. Consequently, when GDP is used to examine economic performance as commodity prices fall, the effect of falling commodity prices is shown predominantly as a deflationary pressure in the GDP deflator.[4]

Real GNI, on the other hand, focuses on the purchasing power of the income earned by Canadians. It is a measure closely aligned with aggregate demand and with material well-being that encompasses changes in real GDP, trade-related changes in relative prices (notably the terms of trade), and changes to international income. Real GNI thus provides more information about the importance of the relative price shock as it affects the ability of Canadian households, businesses and governments to consume and invest. It is important to note that real GNI also provides information about the mechanisms through which the shock was transmitted to the Canadian economy.

To illustrate the difference in the effect of falling commodity prices on real production and their effect on real income, Chart 2 compares the quarterly annualized growth of real GDP and real GNI. Starting at the second quarter of 2014, when commodity prices and the terms of trade started falling, real GNI growth decelerated. In contrast, real GDP growth dipped in 2014 Q3, but stood at 2.5% at an annualized rate in 2014 Q4. Both measures then reported negative growth for the first two quarters of 2015. Real GNI declined by 5.3% in 2015 Q1 and by 1.8% in 2015 Q2 while real GDP declined by 1.1% and 0.4% in Q1 and Q2 respectively. During the latter half of 2015, real GDP growth returned (particularly in Q3) while real GNI growth was weaker. As commodity prices continued to decline, real GDP growth strengthened in 2016 Q1 before falling and rebounding as wildfires in Fort McMurray disrupted production. Real GNI followed an opposing trajectory, first declining in 2016 Q1 as commodity prices fell, then rising in 2016 Q2 as commodity prices increased, and posting similar growth to GDP in 2016 Q3. Over the period since 2014 Q1,

Chart 2
Growth of real gross domestic product versus real gross national income

percent change, quarter-over-quarter, at annualized rates



Note: BCPI stands for Bank of Canada commodity price index. Q stands for quarter.
Sources: Statistics Canada, CANSIM tables 176-0075 and 176-0064.

3. See: http://www.statcan.gc.ca/daily-quotidien/160831/dq160831b-eng.htm.
4. More generally, when GDP is examined, relative-price changes lead to inflationary or deflationary pressures in the GDP deflator. They are assumed to affect the price level, but not the level of real production. In practical terms, this means that a fall in oil prices, and a concomitant decline in the value of the Canadian dollar, which raises import prices, will lead to a deterioration in Canada's terms of trade. In the GDP deflator, the terms-of-trade adjustment is assumed to be a price phenomenon, and the price of exports and imports adjusts. Alternative measures for aggregate real income, such as the real GNI concept discussed in this article, treat terms-of-trade changes as volume effects rather than price effects. This allows terms-of-trade changes to influence the course of real variables, such as real GFCF. For more information, see Kohli (2004, 2006) and Macdonald (2010).

real income (GNI) declined by more, and had weaker growth for longer, than did real production (GDP).

A partial correction

The difference between real GDP and real GNI comes from two non-production sources. The first is the trading gain, which captures changes in the purchasing power of production due to trade-related relative-price changes (primarily the terms of trade). For Canada, terms-of-trade changes are synonymous with changes in resource prices, and they constitute the most important source of non-production real-income growth.[5] The second is the effect of international income, which accounts for income earned abroad by Canadians and income earned in Canada by foreigners.

From the early 2000s to 2015, the non-production sources of real-income growth contributed significantly to real GNI, leading it to grow more rapidly than real GDP. The effect of non-production sources can be seen in Chart 3 as the difference between real GDP (the dashed black line) and real GNI (the solid blue line). From the early 1980s to late 1990s, non-production sources of real-income growth had a minor effect. While they were present, their contribution was small compared to changes in real GDP, and the two series moved in tandem as a result. However, the effect of non-production income sources became more pronounced between 2000 and 2016. This covers a period of rising and falling resource prices that has been characterized as a commodity super-cycle.[6] The effect of non-production sources during this period was to create a significant divergence between real GDP and real GNI, one that persisted even as resource prices cycled downward.

As of 2016 Q3, the price of commodities important to Canada, as measured by the BCPI, had returned to a level similar to that observed in late 2003 and early 2004. However, while smaller, the gap between real GDP and real GNI persisted and was nevertheless significant in 2016 Q3. This can be seen in Chart 4, where the cumulative growth in the BCPI is compared to the cumulative contribution of the non-production factors of real-income growth. Both series use 2003 Q1 as a base, and can be interpreted as the compound growth experienced from that date forward or backward through time. The series are shown on different axes given the differences in the magnitudes of the changes that occurred.

Chart 3
Cumulative growth of real gross domestic product versus real gross national income

Note: Q stands for quarter.
Sources: Statistics Canada, CANSIM table 380-0065.

Chart 4
Bank of Canada commodity price index and non-production sources of real-income growth (cumulative effect)

Note: BCPI stands for Bank of Canada commodity price index. Q stands for quarter.
Sources: Statistics Canada, CANSIM tables 380-0065 and 176-0075.

5. See Macdonald (2010) and Baldwin and Macdonald (2012).
6. See Macdonald (forthcoming), Poloz (2015) and Morgan Stanley (2013).

Between 1981 and 2014, a positive correlation existed between commodity prices and the non-production sources of real-income growth. This relationship was maintained during the commodity boom, and for much of the downturn that followed. The collapse of commodity prices from mid-2014 to 2016 Q1, however, shows a disconnect from this relationship. The non-production sources of growth did not fall as much as could have been expected given the size of the commodity price collapse and their historical relationship with commodity prices.

From real production to real income

To move from real production (real GDP) to real income (real GNI) requires two steps. The first is to adjust real GDP for the trading gain, which reflects changes in the purchasing power of real production.[7] The second is to adjust for international income flows. Of the two, the former is the more important for real-income growth, and it is the source of growth whose behaviour changed significantly around the middle of the 2000s (Chart 5).

Chart 5
Trading gain and net income from abroad, cumulative growth differential since 2002 Q1

Note: Q stands for quarter.
Sources: Stastistics Canada, CANSIM table 380-0065.

The trading gain itself consists of two effects: a real exchange rate effect and a terms-of-trade effect. The real exchange rate used here captures the effect of earning more (or less) in real terms from net exports in terms of domestic commodities.[8] The trade-off between the price of traded commodities and the price of domestic commodities is approximated as the trade-off between an average of export and import prices versus the domestic price level. It is not the same as the relative price-level-adjusted nominal exchange rate, commonly referred to as the "real exchange rate" in macroeconomics. In general, the effect of the real exchange rate on real-income growth is quite small for Canada.[9]

The terms of trade—the ratio of export prices to import prices—is more important. It captures changes in the volume of imports that can be purchased with a given volume of exports resulting from changes in their relative prices. When the terms of trade deteriorate, for example, because oil prices are falling, the volume of imports that each barrel of oil can purchase declines.

During the resource boom, commodity-price-driven terms-of-trade improvements led to significant increases in Canada's trading gain. Between 2001 Q3 and 2008 Q3, the trading gain added 1.1 percentage points to the average quarterly annualized growth rate of real GNI (Table 1). Once commodity prices began declining, the contribution of the trading gain became negative, subtracting 5.8 percentage points from average quarterly annualized real-GNI growth during the global recession and 0.9 percentage points between 2011 Q2 and 2016 Q2.

The effect is larger when the recent collapse in commodity prices is examined separately from the period of slowly declining commodity prices that occurred following the recovery from the 2008-2009 recession. During the period after 2014 Q2, when commodity prices declined sharply, the terms of trade subtracted an average of 1.3 percentage points from real GNI growth. This was roughly 22% of the size of the shock from the trading gain during the 2008-2009 recession.

The second factor that contributes to differences between real-GNI growth and real-GDP growth is net income from abroad (NIFA). NIFA captures the effect of foreign investment and foreign workers. When a Canadian company repatriates earnings from foreign investments, the amount of money available to purchase goods and services in Canada rises, and the opposite occurs when foreign companies repatriate earnings from their investments in Canada. Similarly, when foreigners earn income in Canadian labour markets, it then leaves the country.[10] In both

7. In the 2008 System of National Accounts, this creates a measure of real income referred to as "real gross domestic income" (real GDI). Real GDI and real GNI perform similarly for Canada (see Baldwin and Macdonald [2012]). However, because real GDI does not require a complete balance of payments (it uses only the trade balance), its data requirements are less than those for real GNI. Consequently, real GDI is available for a larger number of countries (see Macdonald [2010]) and for the provinces (see Macdonald [2007]).
8. See Kohli (2004, 2006).
9. See Macdonald (2010) and Baldwin and Macdonald (2012).
10. This is different from remittances, which represent income earned in Canada, by a resident, who then sends it outside of the country.

Table 1
Sources of real gross national income growth

	Contribution to real gross national income					
	Real gross domestic product	Trading gain	Real exchange rate	Terms of trade	Net income from abroad	Real gross national income
			percent[1]			
2001 Q3 to 2008 Q3	2.6	1.1	-0.1	1.1	0.1	3.8
2008 Q3 to 2009 Q2	-6.1	-5.8	0.1	-5.9	-0.1	-11.7
2009 Q2 to 2011 Q2	3.2	1.7	0.0	1.7	-0.1	4.9
2011 Q2 to 2016 Q3	1.9	-0.9	0.0	-0.9	0.1	1.1
2011 Q2 to 2014 Q2	2.6	-0.4	0.0	-0.4	0.0	2.2
2014 Q2 to 2016 Q3	1.2	-1.3	0.0	-1.4	0.1	-0.1

1. Percent change, annualized rates.
Note: Q stands for quarter.
Source: Statistics Canada, CANSIM table 380-0065.

cases, the level of income earned by Canadians is different from the level of income earned in Canada.

The effect of real NIFA on real GNI tended to be positive from the mid-1990s to the mid-2000s. That decade saw important changes in Canadians' ability to invest internationally, which led to increased stocks of Canadian foreign investments.[11] These investments, in turn, contributed to rising income earned abroad by Canadians compared with the income earned in Canada by foreigners. Consequently, during the resource boom, there were an additional 0.1 percentage points of average quarterly annualized real-GNI growth that came from real NIFA. Around the 2008-2009 recession, the contribution of real NIFA became negative, but it returned to making positive contributions to growth after 2010.

The non-production sources of real-income growth created a divergence between real-GDP growth and real-GNI growth during the resource cycle. During the upswing, real-GNI growth outpaced real-GDP growth, while the converse occurred during the downswing. Over this period, real GNI exhibited greater variability and a greater range of growth rates than did real GDP. Moreover, as noted above, the downswing did not completely unwind the effects of the upswing.

In practical terms, this means that gains in real GNI (real income) over and above the gains from increases in real production (real GDP) persisted in the economy even after resource prices (the main source of the gains) had returned to levels similar to those observed at the start of the cycle. That this gap had not closed as resource prices declined is important for two reasons.

First, it illustrates that the effects of the resource boom were not wholly temporary. Previous research supports the notion that resource cycles represent periods where real-income growth can outpace real-production growth, and that a portion of the growth that takes place during the cyclical upswing is permanent.[12] The implication is that, for Canada, the terms-of-trade cycles driven by resource prices have positive long-run effects.

Second, previous research also demonstrates that growth in economic aggregates, such as real investment or real consumption, can depend importantly on non-production sources of real-income growth.[13] Consequently, during periods when changes in the terms of trade become important sources of real-income growth, it is not possible to understand the progression of these types of aggregates by analyzing only real GDP.

The progress of gross domestic product sub-aggregates

In general, over the resource boom, when countries experienced improving terms of trade, their consumption and investment growth outpaced their real-GDP growth. When countries experienced declining terms of trade, their consumption and investment lagged behind real-GDP growth.[14] In effect, the terms of trade behaved much like multifactor productivity, and accelerated growth in material living standards when the terms of trade improved, or held back advances in material living standards when they deteriorated.[15]

For Canada, changes in the terms of trade elicit these types of responses in economic aggregates, and these changes can be difficult to interpret if real GDP is used in isolation. The progress of real consumption, real GFCF and real imports follow paths through time that have a greater relationship with real GNI than with real GDP. In certain cases, such as consumption, the trend growth rate is influenced more than are cyclical factors, while in others, such as real GFCF, cyclical factors can be amplified.

During downturns, relative price changes constitute an important transmission mechanism for shocks affecting the

11. See Gellatly and Macdonald (2012).
12. See Baldwin and Macdonald (2012).
13. See Macdonald (2010).
14. See Macdonald (2010).
15. See Diewert and Morrison (1986).

Table 2
Growth of real gross domestic product components

	Final consumption expenditure	Gross fixed capital formation	Exports of goods and services	Imports of goods and services	Real gross domestic product	Real gross national income
			percent[1]			
2001 Q3 to 2008 Q3	3.3	4.8	1.0	4.9	2.5	3.8
2008 Q3 to 2009 Q2	0.0	-18.5	-21.2	-21.4	-6.0	-11.7
2009 Q2 to 2011 Q2	2.7	9.4	5.4	11.8	3.1	4.8
2011 Q2 to 2016 Q3	1.9	-0.1	3.6	1.5	1.9	1.2
2011 Q2 to 2014 Q2	1.8	2.3	5.1	2.6	2.5	2.2
2014 Q2 to 2016 Q3	1.9	-3.1	1.6	0.1	1.2	-0.1

1. Percent change, annualized rates.
Note: Q stands for quarter.
Sources: Statistics Canada, CANSIM tables 380-0065 and 380-0064.

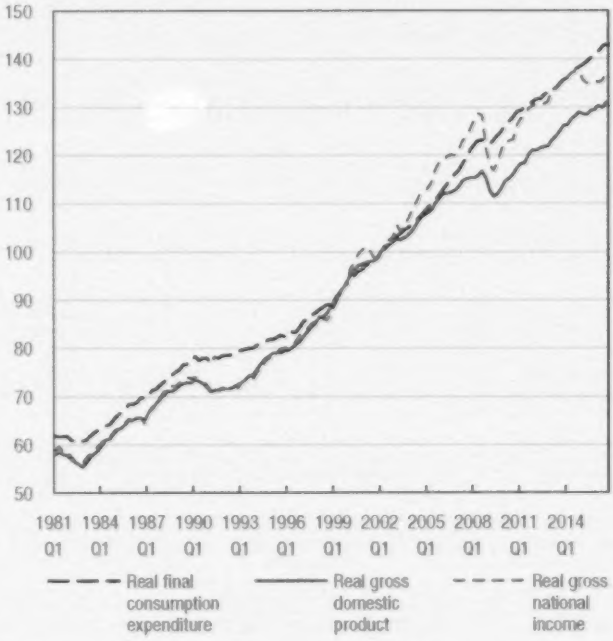
Canadian economy. During the 2008-2009 recession and the downturn in resource prices, changes in components of real GDP typically exhibited growth rate patterns more in line with real GNI than with real GDP (Table 2). During the recession, real imports and real GFCF declined at a quarterly annualized rate of around 20%, while real consumption growth stalled. Real GDP declined by 6% while real GNI declined at nearly double that rate. The relative price shock from falling commodity prices furthered the effect of falling foreign aggregate demand. A similar effect from falling commodity prices occurred after 2011 Q2 when falling commodity prices again transmitted a relative price shock to the Canadian economy. In the latter period, real GDP growth offset some of the relative price effects, but falling commodity prices none-the-less led to weakness in particular real GDP components.

For Canada, the effect of the resource price collapse on real final consumption is not well reflected, but the progression of consumption growth during the resource boom and the period of weakening resource prices that occurred thereafter bear a greater relationship with real GNI than with real GDP (Chart 6).[16] Real final consumption expenditure progressed more rapidly than real GDP during the resource boom, and more slowly than real GDP during the period of weakening commodity prices.

Real final consumption is also the metric in final demand that exhibits the least cyclicality. During the previous three recessions, real consumption did not adjust downward as sharply as aggregate real income, real production or other components of real final domestic demand.

Real GFCF and real imports responded more strongly, and thus reflect the downturn in commodity prices (Chart 7, Chart 8). Real GFCF responded the most over the 2014 Q2-to-2016 Q3 period, declining sharply as commodity prices collapsed. It is also the metric that showed the largest cyclical response to the 2008-2009 recession, as well as the largest gains during the period of rising resource prices.

Chart 6
Real final consumption versus real gross domestic product and real gross national income



Note: Q stands for quarter.
Sources: Statistics Canada, CANSIM table 380-0065 and 380-0064.

Real imports also responded, but to a lesser degree. When changes in the terms of trade occur, the adjustment can take place through changes in real imports, through changes in saving, or through a combination of the two. The relationship between imports and real GNI, since 2001 Q3, rather than the relationship between imports and real GDP during this period,

16. It is important to note, however, that real final consumption includes consumption by households, governments and non-profit institutions serving households. If households are examined in isolation, their real consumption progressed more rapidly than real GDP during the resource boom, but at about the same rate as real GDP during the period of weakening commodity prices.

Chart 7
Real gross fixed capital formation versus real gross domestic product and real gross national income

Note: GNI stands for gross national income. GDP stands for gross domestic product. GFCF stands for gross fixed capital formation. Q stands for quarter.
Sources: Statistics Canada, CANSIM tables 380-0065 and 380-0064.

Chart 8
Real gross fixed capital formation versus real gross domestic product and real gross national income

Note: GNI stands for gross national income. GDP stands for gross domestic product. Q stands for quarter.
Sources: Statistics Canada, CANSIM tables 380-0065 and 380-0064.

illustrates that changes in the terms of trade are an important explanatory variable for real-import growth, and that Canadians make adjustments to the volume of goods and services consumed and invested in response to terms-of-trade shocks.

Conclusion

Canada is a trading nation that depends greatly on natural resource exports to purchase inputs, investment goods and consumer goods. As a result, fluctuations in global resource prices, particularly the price of oil, have important implications for Canada's ability to transform its economic inputs (labour, capital, knowledge, land, natural resources) into the consumer and investment goods and services that Canadian households, firms and governments want to purchase. Real gross domestic product (real GDP) is not well suited to reflect this type of relative price effect.

Although real GDP growth weakened in 2015, it does not fully illustrate the magnitude of the shock that collapsing commodity prices transmitted to the Canadian economy, nor does it allow for an understanding of the recent progression of aggregates, such as real gross fixed capital formation (real GFCF), or real imports. To understand changes in Canadians' ability to consume and invest, it is necessary to look at changes in what that production can buy on world markets when relative prices change (most importantly the terms of trade) and the evolution of net income from abroad. When these effects are included with real GDP, a measure of real income referred to as real gross national income (GNI) can be derived.

Real GNI shows a shock from falling commodity prices many times larger than real GDP in the first quarter (Q1) of 2015, and one that starts earlier and lasts longer. The sources of growth for real GNI show that non-production sources of income, rather than changes in production, tended to be the major source of fluctuations from 2014 Q3 to 2016 Q3. Of these factors, the terms of trade was the most important.

Comparing real-GNI growth and real-GDP growth over the resource cycle illustrates that, while commodity prices fell to levels similar to those observed in the mid-2000s, the positive effect of commodity prices from the boom years were not completely unwound by the middle of 2016, suggesting that part of the gains appear permanent.

Finally, the non-production gains that constitute the difference between real GDP and real GNI are important for understanding the progression of real final consumption, real GFCF and real

imports. The relative-price changes that resulted from rising, and then falling, commodity prices significantly influenced the progress of these variables. As economic theory would suggest, Canadians adjusted their consumption and investment to reflect the changes in relative prices. This adjustment was not accompanied by large changes in real GDP, but the relative importance of real GDP components, such as real consumption and real GFCF, did adapt.

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